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N-63-4-3

NA-63-132

North American Aviation, Inc.

EVALUATION OF A MECHANICAL

FLIGHT CONTROL SERVO

(Title Unclassified)

APRIL 1, 1963

Prepared Under Navy, Bureau of Aeronautics

Contract No. N0w62-1076-A

Interim Report No. 4

Covering Period 2-1-63 to 3-31-63

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INTERNATIONAL AIRPORT

LOS ANGELES 9, CALIFORNIA

LOS ANGELES DIVISION

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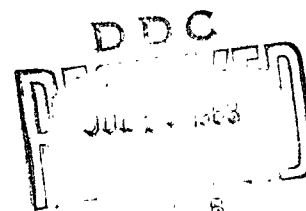
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Navy Department
Washington 25, D. C.



Report No. NA-63-132

INTERNATIONAL AIRPORT
LOS ANGELES 45, CALIFORNIA
ENGINEERING DEPARTMENT

APRIL 1, 1963

Interim Report No. 4

Covering Period 2-1-63 to 3-31-63

Milton Knoff

CONTROL SYSTEMS

APPROVED BY

P. M. MAYER, CHIEF
MECHANICAL SYSTEMS

No. of Pages 8 plus vi

Date 4 April 1963

[illegible]

NORTH AMERICAN AVIATION, INC.
INTERNATIONAL AIRPORT
LOS ANGELES 45, CALIFORNIA

NA-63-132

FOREWORD

This report is a continuation of a mechanical servo evaluation previously reported in North American Aviation Reports NA-62-1105, NA-62-1415, and NAA Letter 63LA5093-262, dated 6 February 1963 and covers the period 1 February 1963 to 31 March 1963 in support of Contract NOW62-1076-d.

Design and detail drawing effort for the installation of the all mechanical system on the F-100 Flight Control System was accomplished by O. Borngesser of Control Systems Group under the supervision of M. Knopf. Servo design and detail effort is being accomplished by Lycoming Division of AVCO Corporation, Stratford, Connecticut.

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ABSTRACT

The release of detail drawings for fabrication, the installation of components, the review of a proposal outline of the Lycoming Toroidal Servo, a design review meeting at Lycoming, and the development progress of the toroidal servo are herein described.

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SUMMARY

Eighty (80) percent of the drawings of components required to adapt the toroidal servo to the all mechanical aileron control system have been released. Fabrication of components are in initial stages. Installation of existing components reassigned to this contract from termination inventory of Contract AF33(600)-39361 has been initiated.

Sixty five (65) percent of the Lycoming XLA4 toroidal servo actuator components are production detail parts of the Lycoming LD6-3 Constant Speed Drive. These parts have been accumulated. Delivery of the completed toroidal servo originally scheduled on 2 March 1963 is now scheduled 3 June 1963. The servo housing is the critical time element component. Preliminary testing for compliance to specification requirements will be initiated 1 April 1963 using LD6-3 assemblies.

In the next 60 day period the Contractor intends to complete the simulator construction and partial installation in preparation for the receipt of the servo. The servo will be completed and acceptance tested at the supplier's facility.

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INTRODUCTION

In preceding progress reports, NA-62-1105, NA-62-1415 and MAA letter 63LA5093-262, dated 6 February 1963, an all mechanical aileron flight control system, was described and analyzed for potential performance. Evaluation of the data obtained by analog techniques resulted in a definition of the specification requirements of a mechanical servo one of five major components of the all mechanical system. The mechanical servo is being procured from the Lycoming Division of Avco under firm fixed price contract.

The following accomplishments were scheduled for this reporting period:

1. Review the design evaluation drawings of the servo.
2. The release for fabrication of the parts required to install the servo on the F100 Flight Control Simulator.

The cost control report plan and progress is shown in figure 3.

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I. SERVO DESIGN AND MANUFACTURING

The proposed installation outline of the toroidal mechanical servo was received from the subcontractor, Lycoming Division of AVCO, for review. Minor technical problems in regard to the location of the feedback mounting provisions and direction of rotation were resolved by exchange of drawings and by telephone conversation.

A design review meeting was held at Stratford, Connecticut on 14 and 15 March 1963. Design concepts of the XLA-4 servo actuator, detail parts configuration, inertia properties, load-torque requirements, and tentative delivery schedule were discussed.

The servo will be protected internally against application of input command forces exceeding 2.5 pounds. This will prevent command of steering angles in excess of safe limits. External protection originally planned would not be acceptable at extreme travel limits because of the probability of high rate command reversals dictated by limit stops.

Internal load analysis of the servo is based on variation in acceleration rates as a function of servo output torques. This phenomena is similar to that existing in a hydraulic system. Specific acceptability of this and other properties of the mechanical flight controls will be proven during the testing phase of this program.

Although long lead times have been reduced by the use of production detail parts contained in the LD6-3 Constant Speed Drive comprising sixty-five (65) percent of the servo components, the delivery date of 3 June 1963 is dictated by the servo housing. It is unlikely that delivery can be accomplished earlier than this date and unforeseen difficulties might cause further delays. No extension of Contract NOW62-1076-d is contemplated at this time unless further slippage of delivery of the servo occurs.

Because of the similarity of the ratio changer section of the servo actuator to the LD6-3 Constant Speed Drive, preliminary testing of compatibility to the XLA-4 specification requirements can be initiated during the week of 1 April 1963 and prior to completion of the XLA-4 parts.

II. DRAWING RELEASE STATUS

Drawings required to adapt the toroidal mechanical servo to the existing all mechanical aileron flight control system are eighty (80) percent complete. These drawings are listed in Table I, page 4. Adaptation of the source of power to the simulator is scheduled for release by 15 April 1963.

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III. MANUFACTURING STATUS

Components withdrawn from termination inventory of Contract AF33(600)-39361 and assigned to Contract NOW62-1076-d are listed in Table II. These parts are now available at the test site and are being installed. The photographs of installation status of some of these parts are shown in figure 2 and 3, pages 6 and 7.

Components of the feed-back drive are in initial fabrication stages and are scheduled to be completed by 15 May 1963.

Miscellaneous linkages and levers have also been released to Manufacturing with completion schedules compatible with installation requirements.

The power source, a modified F-100 ground power unit, is scheduled to be delivered to the simulator by 1 May 1963.

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TABLE I

List of Drawings Released for Fabrication and Installation

<u>Drawing Number</u>	<u>Drawing Name</u>
2563-075201	Mechanical Servo & Linkage Instl.
2563-075202	Lever
2563-075203	Bell Crank
2563-075204	Support
2563-075205	Bell Crank
2563-075208	Bell Crank
2563-075209	Support
2563-075210	Clevis
2563-075230	Feed Back Assy
2563-075231	Housing
2563-075232	Stop
2563-075233	JackscREW
2563-075234	Cap
2563-075235	Spacer
2563-075236	Retainer
2563-075237	Shim
2563-075238	Cover
2563-075239	Link
2563-075240	Clevis
2563-075241	Rod End
2563-075242	Turnbuckle

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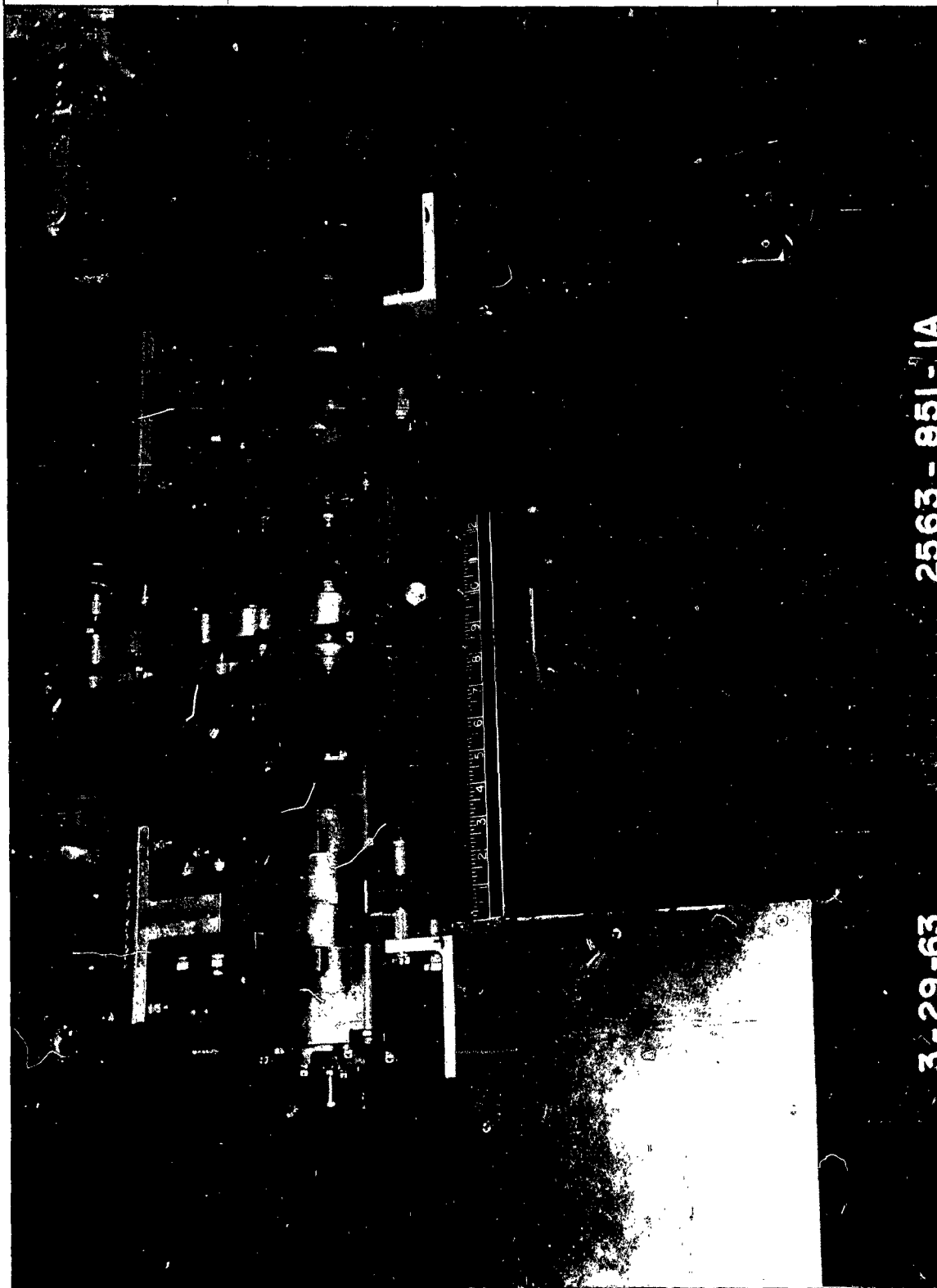
NA-63-132

TABLE II

List of Parts Temporarily Transferred to NOW62-1076-d from Terminated Contract AF33(600)-39361 Inventory.

<u>Part No.</u>	<u>Part Name</u>	<u>Part No.</u>	<u>Part Name</u>
L-11868B	Jig	164536	Rt. Angle Drive
164423	Unidirect Shaft	9721-523008	Bell Crank
164829	Rate Changer		Assy.
165098-1	Hinge	9721-523009	Idler-4 Bar
165099-1	Hinge	9721-523010	Belcrk. Assy..
165280	Gear Box	9721-523011	Belcrk. Assy..
165379	Shafting	9721-523012	Rod Assy.
165379-1	Shafting	9721-523013	Rod Assy.
165495	Shafting	9721-523014	Rod Assy.
165715	Shafting	9721-523015	Arm
430169	Shaft	9721-523016	Rod Assy.
180-16036-3	Race	9721-523017	Link Assy.
192-16522	Link Assembly	9721-523018	Link Assy.
192-547109	Nut	9721-523020	Bungee Assy.
223-54711	Spring	9721-523026	Belcrk. Assy..
9721-071401-3	Fitting	9721-523027	Rod Assy.
9721-071401-5	Fitting	9721-523028	Belcrk. Assy..
9721-071401-7	Fitting	9721-523030	Link Idler
9721-071401-9	Fitting	9721-523050	Rod Assy.
9721-071401-11	Fitting	9721-523051	Bungee Assy.
9721-071401-13	Fitting	9721-952301-7	Weld Assy.
9721-071401-14	Fitting	9721-952301-19	Bolt
9721-071401-39	Fitting	9721-952301-21	Plate
9721-071401-40	Fitting	9721-952301-27	Angle
9721-071401-41	Plate	9721-952301-29	Angle
9721-071401-43	Cam	9721-952302-3	Support Assy.
9721-071401-45	Shaft	9721-952302-5	Support Assy.
9721-071401-47	Lug	9721-952302-7	Support Assy.
9721-071401-49	Clevis	9721-952302-45	Plate
9721-071401-69	Fitting	9721-952304	Belcrk. Assy..
9721-071401-107	Fitting	9721-952305	Belcrk. Assy..
9721-523034	Adjustable Belcrk.	9721-952307	Belcrk. Assy..
	Clutch	9721-952308	Belcrk. Assy..
9721-523035	Bungee Assy.	9721-952309	Belcrk. Assy..
9721-523041	Strap		
9721-523042	Clamp		
9721-523043-13	Support		
9721-523043-15	Support		
9721-523044	Support Assy.		
9721-523045	Support Assy.		
9721-523046	Support Assy.		
9721-523047-1	Support Assy.		
9721-523047-2	Support Assy.		
9721-523048-1	Support Assy.		
9721-523048-2	Support Assy.		
9721-523049-1	Support Assy.		
9721-523049-2	Support Assy.		
9721-547001	Actuator		

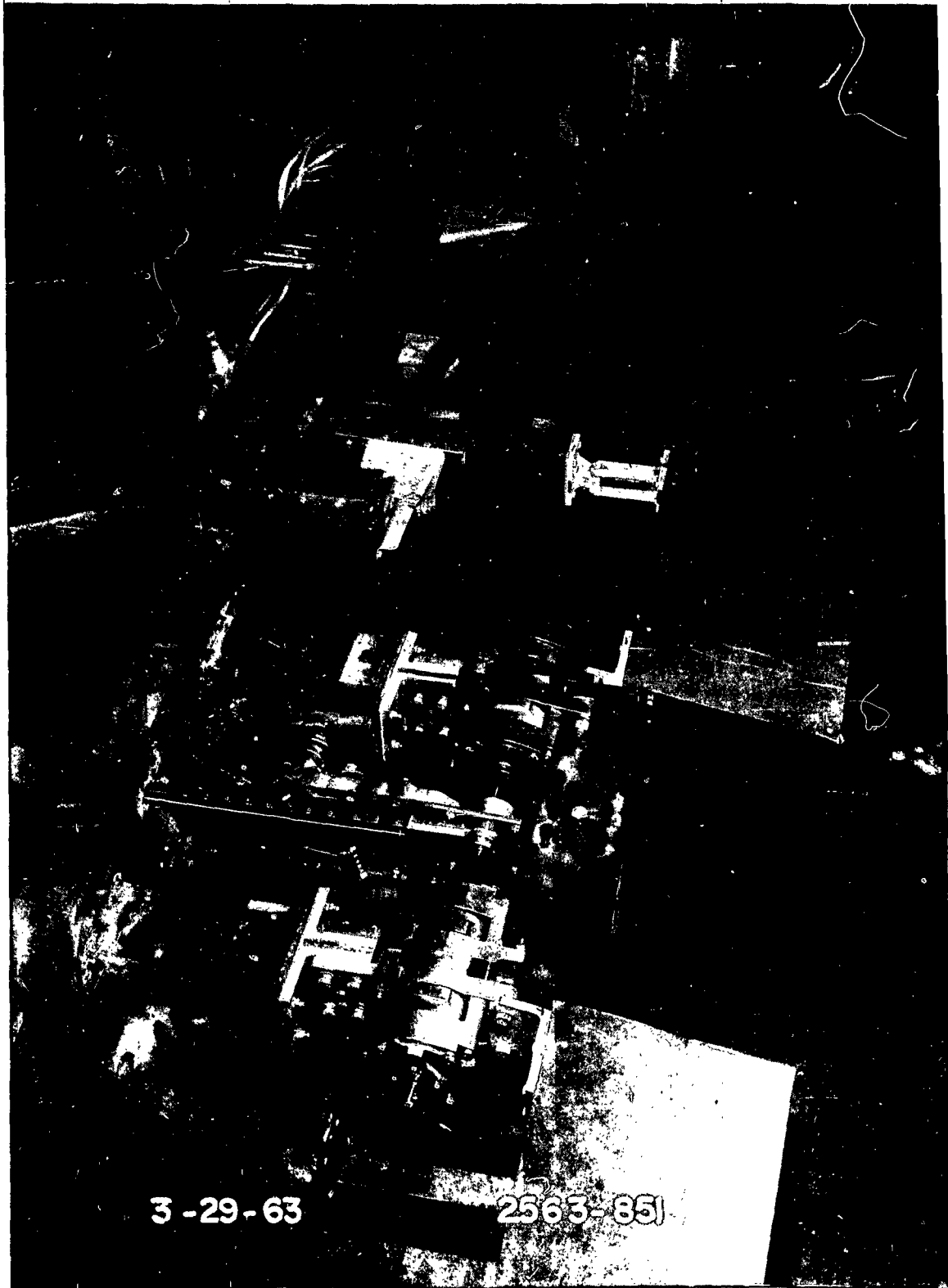
PREPARED BY:	NORTH AMERICAN AVIATION, INC. AILERON SURFACE CONTROL MECHANICAL ACTUATOR AND GEAR BOX INSTALLATION	PAGE NO. 6 OF
CHECKED BY:		REPORT NO. NA-63-132
DATE:		MODEL NO.



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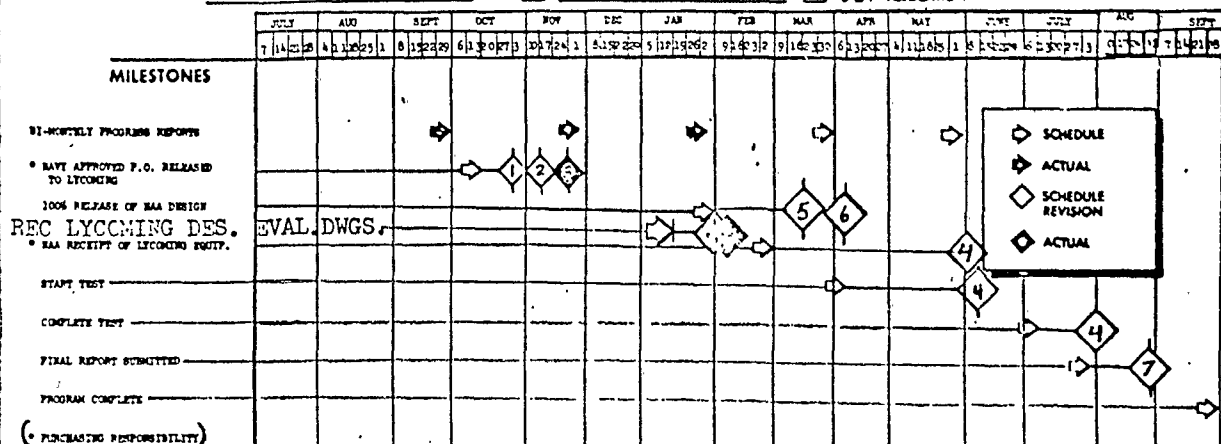
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PREPARED BY:	NORTH AMERICAN AVIATION, INC. AIRFLOW SURFACE CONTROL AND WING INSTALLATION	PAGE NO. 7 OF
CHECKED BY:		REPORT NO. NA-63-132
DATE:	FIGURE 2	MODEL NO



RESEARCH & DEVELOPMENT DIVISION COST CONTROL REPORT PLANS AND PROGRESS

REPORTING DATE 3-28-63
DATA AS OF 3-28-63
REPLACES _____

CONTRACT S.O. 2563
TYPE C777
TITLE EVALUATION OF A MECHANICAL FLIGHT CONTROL SERVO
☐
☐
☒ FIRM ALLOCATION
☐ S & P ALLOCATION


(1) DELAY DUE TO ADDITIONAL TIME REQUIRED TO OBTAIN A FIRM BID FROM SUPPLIER AND APPROVAL BY THE PROCURING AGENCY.

CUMULATIVE (2) TO EVALUATE DEVIATIONS FROM NA5 PROCUREMENT SPECIF. REQUESTED BY LYCOMING

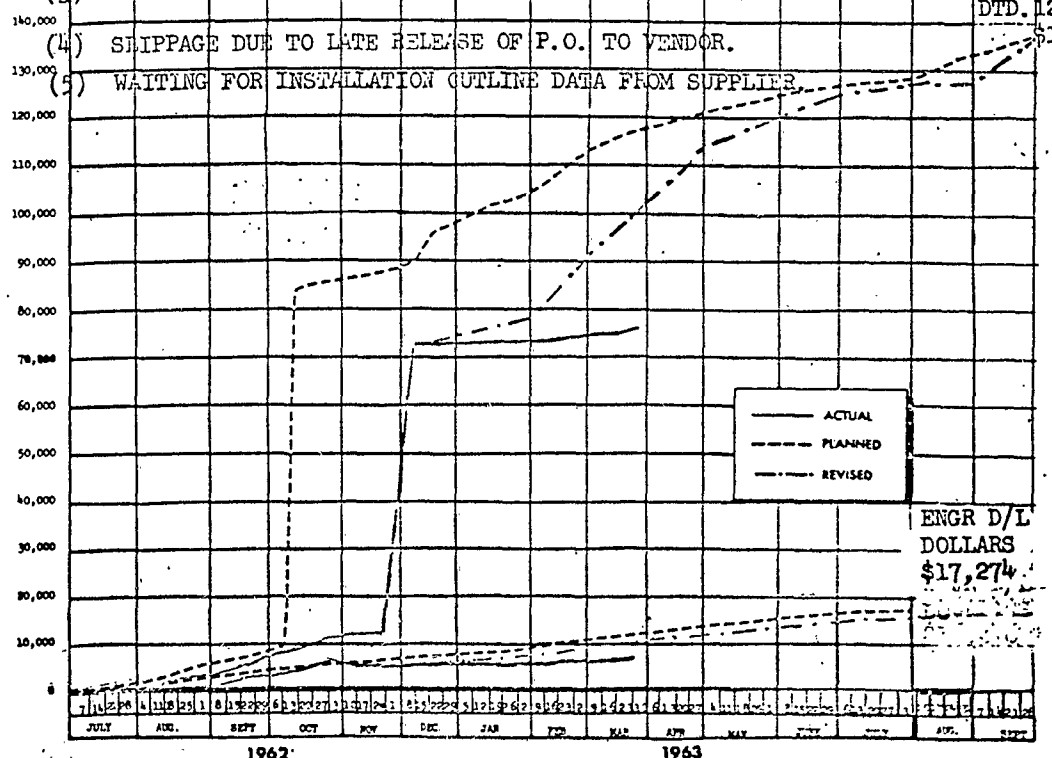
(3) DELAY DUE TO TIME REQUIRED TO APPROVE P.O.

(4) SHIPPAGE DUE TO LATE RELEASE OF P.O. TO VENDOR.

(5) WAITING FOR INSTALLATION OUTLINE DATA FROM SUPPLIER.

(6) DUE TO LATE RECEIPT OF INSTALLATION OUTLINE DATA FROM VENDOR.

(7) CONTRACT CALLS FOR REPORT DELIVERY ON OR BEFORE 29 AUGUST 1963.



* REVISIONS FOR WORK IN APR 1963 - NOV. 1963

FIGURE 3